hydrogen gases thus furnished are to be employed in smelting the carboniferous ore of iron, which is reduced by the hydrogen at the high temperature of the flame, thus producing at one operation either steel or pure malleable iron at will. Signor Guidi states, however, that to turn out two tons daily would require the constant employment of a 120 horse-power engine.

GEOGRAPHICAL NOTES

THE Lisbon correspondent of the *Daily News* telegraphs that Ivens and Capello have arrived ill at Loanda, after two years' exploration. They are suffering from fever and other complaints induced by privation, and were almost without clothes. According to government instructions, they have completed a general map of Loanda. They explored the rivers Quango and Quanza, and the territories bordering on their basins. They could not descend the Quango to its confluence with the Zaire on account of the resistance of the hostile tribes. Capello appears quite old, and hardly recognisable. Ivens is better, though ill. Both are thorough scientific men. They bring important notes extending over 32 degrees, plans of the territories and the roads, and meteorological, magnetic, and geographical observations made with the excellent instruments they carried. They were well received by the chief of the Motiango territory, from which the German explorer, Schultz, was excluded; but the chief would not allow any white man to pass east at the peril of his life. They visited the highlands of Bihé, and explored several rivers to their sources. Nearly all their followers deserted them. They were received with great enthusiasm on their arrival at Loanda, and will go to Mossamedes to recruit, prepare their plans, and write out their observations. The period of their return to Lisbon is uncertain.

AT a late meeting of the Russian Geographical Society some details were communicated as to the expedition exploring North-Western Mongolia under M. Potanin. In a letter the traveller describes his route during July and August, which first led from Tsoosilan to the River Kharkiri, and thence to the Lake of Khirghisnor, layers of coal being found on the way. The banks of that lake being barren, the explorers halted near Lake Baganor, only six versts distant from the other sheet of water. Khirghisnor is a great deal larger than Lake Kharaous, and the Mongols asserted the existence of only two such immense reservoirs in the country—namely, the Oobsa and the Kirghisnor. From the latter the expedition marched south, with intent to strike the point where the waters of Lakes Kharaous and Durganor fall into Dzabchin. On August 4 the travellers came to the salt lake Dzerennor, and not till the 9th did they reach the banks of the River Tachteteli, that being the name applied to the mingled volumes of the large lakes flowing into the Dzabchin. Marching round the southern part of Lake Kharaous, the explorers then arrived at the town of Kobda on September 1, with rich scientific collections of all kinds. M. Potanin intended again making for Oolangol, thence proceeding to Oolookem.

THE committee of the Dutch Arctic Expedition have made known their determination to fit out, for the third time, their little sailing schooner *Willem Barents*. The cost of the new expedition is estimated at a little over 1,000*l*.

AFTER the presidential address and the paper on Sumatra read at the first meeting of the session, the new number of the Geographical Society's periodical gives us some notes on the Cocos or Keeling Islands, from the pen of Mr. H. O. Forbes, who went out to the East in October of last year for the purpose of investigating the fauna and flora of certain districts in the Malay Archipelago. While in Java, before commencing this work, he availed himself of an opportunity of paying a visit to these far-away islands, in order to ascertain what changes had occurred since the visit of H.M.S. *Beagle* in 1836; these are shown on the map accompanying his paper. Next we find a note on the boundary line between Chili and Bolivia, illustrated by a map, which explains to some extent the existing disturbances in South America. The geographical notes furnish an account of the progress being made towards Lake Tanganyika by Dr. Mullen's successors, the late Mr. Frank Oates's researches in Matabeleland, and Major Biddulph's tour in Chitral and Yassin. There is also some information of interest respecting Transcaucasia.

A CONTRACT has been concluded by the Molala Shipbuilding ompany, Sweden, to construct a steamer of Molala Bessemer teel, of 100 horse power, to trade between China and Siberia.

FROM the Abstract Report of the Indian Surveys for 1877-8 we see that a large amount of work was done during the season by the various departments, all now united under one organisation. Some interesting and important details are given of various trans-frontier explorations.

THE October *Bulletin* of the Paris Geographical Society begins with a long and valuable paper by M. Wiener on the Dead City of Gran-Chimu and the city of Cuzco. The paper is accompanied by large and careful plans of the two cities, and we believe is a valuable contribution to a puzzling problem. Admiral Fleuriot de Langle has a paper on African migrations, and M. Jules Girard on the subsidence of the surface of the Low Countries. M. Hamy gives an interesting *compte rendu* of M. G. Retzius's recent work on Finnish Ethnology.

THE ROYAL SOCIETY

THE anniversary meeting of the Royal Society was held on December 1, and a somewhat long address was read by the President Mr. Spottiswoode. After referring to some of the losses by death which the Society had sustained, he passed on to business which has occupied the attention of the Council during the current year.

Two important contributions to the Society's funds are announced. First, an unconditional bequest of 1,000*l*. by the late Mr. Sidney Ellis, of Leicester; and secondly, a legacy by the late Sir Walter Trevelyan, "the interest of which is to be applied to the promotion of scientific research."

The Royal Society, as is well known, possesses a rather extensive gallery of portraits, almost exclusively of Fellows of the Society, but among them also a fine painting of Lord Chancellor Bacon. Many of these portraits, however, have, through the lapse of time, begun to show signs of decay. Acting under the advice of Mr. F. W. Burton, F.S.A., Director of the National Gallery, the Council has entrusted the pictures which seemed most to require attention to the care of Mr. Dyer, of Orchard Street, who is now engaged upon them. Some of the portraits require lining, and others cleaning, or partial restoration. As will be seen from those which have been returned to their places, the work appears to have been done in a satisfactory manner. The present appearance of the pictures has been much improved, and it is hoped that these interesting portraits of those who have gone before us may now be passed on in an unimpaired condition to future generations.

Among other acquisitions 973 portraits of Fellows of the Royal Society, formed by the late J. P. Gassiot, Esq., F.R.S., have been bought during the past year. The collection consists mainly of engravings, many of which are of great artistic merit, and in excellent condition.

During the past year a small but perhaps not unimportant change in the mode of dealing with the papers to be read at the weekly meetings has been made. This consists first, in deciding a week earlier than heretofore, what papers should be advertised for reading: and secondly, in reading each week as many as practicable of those in hand, so as to leave as few as possible to stand over. The weekly journals are now able to announce to the public the papers which will be read at the Royal Society (as has in fact long been the case with other Societies) during the next week. But the main object of this arrangement has been early publication; that is to say, publication both in its technical sense of reading before the Society, and in its more widely accepted sense of appearance in the Society's Proceedings. When this was first proposed, it was feared there would soon arrive a period of scientific famine, and that occasions might occur when the Society would meet with no papers before it. Whether this would be so great a calamity as was at first imagined is still an open question, for such has been the scientific fertility of the season, that the threatened catastrophe has never yet actually occurred.

"But so far from suffering by a deficiency of matter we have more often found our difficulties in the number of papers to be read in a single evening. And on such occasions the Secretaries have been good enough to take especial pains to make themselves masters of the contents of the papers, and to communicate in a few words to the meeting the substance of each. It is, I believe, not too much to say that the 'reading' of papers carried out in this way has been the most agreeable and instructive, and has been particularly provocative of intelligent and pertinent discussion. . . . .

"There is a possible alteration in our arrangements which

has often appeared to me to be worthy of consideration, and which from conversations with some of our Fellows appears to meet with sufficient support to justify my bringing it before this our anniversary. I refer to the hour at which our weekly meetings are held. Hitherto, in accordance with the usage of scientific societies in London, we have met in the evening. But changes in the habits of society, and the increasing distances from Burlington House at which many of our Fellows reside, seem to render a large weekly attendance difficult. On this account it appears to me desirable to inquire whether an afternoon hour might not better suit the convenience of our members. In that case, I should suggest 5.0 P.M.; and as our meetings seldom extend to two hours in duration, it would generally be practicable for Fellows to reach home by about seven o'clock. . . .

"These changes, if adopted, would require the alteration of the Statute relating to the hour of meeting. But if the suggestion were adopted before the end of the year, there would still remain nearly half the Session of our Society after complying with the necessary formalities. . . .

"It has often been suggested," we read, "that our weekly meetings might be rendered more interesting if the communications were more often accompanied by experiments, or by other modes of optical illustration. The Council has hitherto met these requirements by supplying, from time to time, such appliances as appeared necessary. But that important element, the electric light, and batteries on a large scale, have generally been avoided, on account of the inconveniences attending them. It has, however, been thought that authors would be much encouraged to illustrate their communications experimentally if the main appliances were known to be always ready to hand. . . .

"Again, the mode of lighting our meeting-room by means of sunlights has proved inconvenient to many of our Fellows, on account of its heat and glare; and it is considered undesirable to adopt ordinary gas-burners in its stead for fear of injury to the pictures. We are, however, no longer driven to this alternative, as we may now look to the electric light as a possible mode of illumination.

"These considerations have led me to make an offer, as I now do, to the Society, of a gas-engine of eight horse-power, which, in the opinion of those best qualified to judge, will be amply sufficient both for experimental illustration and for illumination. And I have much pleasure in adding that, on hearing of this offer, our Fellow, Mr. Siemens, immediately expressed his wish to add a dynamo-machine, or rather a pair of such machines, of improved construction (one for alternate, the other for direct currents), the principle of which he had already contemplated bringing before the Society. The other requisites, such as an optical lamp and a few instruments of frequent use, will doubtless soon follow. But, in proposing thus to promote experimental illustration of papers read before the Society, I think it right to add that I do not contemplate, nor do I think it desirable, that the Society should in any sense establish a laboratory; all that is here intended is, that the main appliances for illustration should be found ready to hand here, while the special apparatus would be furnished by the authors themselves."

With regard to the government grant and fund, it is in the opinion of the President desirable that the minds, not only of the Council, but also of the Fellows generally should during the present year be turned to the question, whether it is advisable, in the interests of science, that the fund should be maintained: and if so, whether in its present or any altered form?

In May last the Secretary of State for India asked the advice of the Royal Society on the question of deputing to this country Major J. Herschel on the subject of pendulum observations. The subject is one in which the Royal Society has on more than one occasion taken an active interest; and a reply, prepared by Prof. Stokes was sent. Major Herschel is on his way to England, to carry out the proposed work.

The Publications of the Society. — The Catalogue of Scientific Papers.—The second volume of the supplementary decade, viz., 1863–73, has been brought to a close, and copies are now in the hands of the Fellows and the public. It exceeds in bulk any of the earlier volumes of the work, and extends to 1,310 pages. In this supplement, 343 additional scientific serials have been catalogued, making the total of such serials now comprised in the whole no less than 1,938. The donation list for this volume has been the same as that for former volumes, with the addition of a few societies and institutions sanctioned by the Treasury at the recommendation of the Council. The Fellows have the right to purchase the supplement at the same reduced price per volume as the original work. The Council has authorised the preparation of titles for another decade; and some progress has already been made in the work.

An extra volume of the *Philosophical Transactions* (vol. 168) has been issued, in which the observations made by the naturalists who accompanied the Transit of Venus Expeditions to Kerguelen's Land and Rodriguez, and descriptions of their collections by persons specially acquainted with the several subjects are brought together. The volume is divided into four sections, viz., the Botany and Zoology of each of the two islands respectively.

In estimating the affinities of the flora and fauna of Rodriguez, the authors were under great difficulties owing to our imperfect knowledge of the plants and animals of the other Mascarene Islands. But almost all their observations point strongly to the conclusion that the present animals and plants are the remains of a once more extensive flora and fauna which has been gradually broken up by geological and climatic changes, and which more recently has been greatly interfered with by the agency of man.

The papers presented to the Society, and read at the evening meetings, are stated to have been more numerous than in any previous year of its existence, and have during the last twelve months reached a total of 118. Some of them appear to have excited unusual interest among the Fellows and their friends; for, on more than one occasion the meeting-room was filled to an almost unprecedented degree.

The President took the opportunity of expressing his own impressions of a few which fall, more or less, within his own range of study, first of all referring to the assiduity and success with which Mr. Crookes has continued his labours.

The work of the Institution of Telegraph Engineers, the Iron and Steel Institute and other similar associations was then referred to.

The justification for the award of the medals for the present year was thus stated:—

The Copley Metal has been awarded to Rudolph Julius Emmanuel Clausius, Foreign Member of the Royal Society, for his investigations in the Mechanical Theory of Heat.

The mechanical theory of heat as at present understood and taught has been so essentially a matter of growth, that it would be difficult to assign to each investigator the precise part which he has taken in its establishment. It will, however, be admitted by all, that the researches of Clausius rank high among those which have mainly contributed to its development. These researches extend over a period of thirty years, and embrace important applications of the theory not only to the steam-engine, but to the sciences of electricity and magnetism.

Even to enumerate those who have contributed to one branch of the subject, viz., the kinetic theory of gases, would be beyond my present purpose and powers; but as Clausius himself states, both Daniel and John Bernoulli[1] wrote on the subject. And, even, to go back to earlier times, Lucretius[2] threw out the idea; while Gassendi, and our own Boyle, appear to have entertained it. Within our own recollection, Joule, Meyer, Kroning, Clerk Maxwell, and others have made invaluable contributions to this branch, as well as to the general subject of the mechanical theory of heat. But however great the value of these contributions, it may safely be stated that the name of Clausius will always be associated with the development of earlier ideas into a real scientific theory.

A Royal Medal has been awarded to W. H. Perkin, F.R.S. Mr. William Perkin has been, during more than twenty years, one of the most industrious and successful investigators of Organic Chemistry.

Mr. Perkin is the originator of one of the most important branches of chemical industry, that of the manufacture of dyes from coal-tar derivatives.

Forty-three years ago the production of a violet-blue colour by the addition of chloride of lime to oil obtained from coal-tar was first noticed, and this having afterwards been ascertained to be due to the existence of the organic base known as aniline, the production of the coloration was for many years used as a very delicate test for that substance. The violet colour in question, which was soon afterwards also produced by other oxidising agents, appeared, however, to be quite fugitive, and the possibility of fixing and obtaining in a state of purity the aniline product which gave rise to it, appears not to have occurred to

1 In the 10th section of his "Hydrodynamics."
2 "De rerum Naturâ," lib. ii. 111–140.

chemists until Mr. Perkin successfully grappled with the subject in 1856, and produced the beautiful colouring matter known as aniline violet, or mauve, the production of which, on a large scale, by Mr. Perkin, laid the foundation of the coal tar colour industry.

His more recent researches on anthracene derivatives, especially on artificial alizarine, the colouring matter identical with that obtained from madder, rank among the most important work, and some of them have greatly contributed to the successful manufacture of alizarine in this country, whereby we have been rendered independent of the importation of madder.

Among the very numerous researches of purely scientific interest which Mr. Perkin has published, a series on the hydrides of salicyl and their derivatives, may be specially referred to; but among the most prominent of his admirable investigations are those resulting in the synthesis of coumarin, the odoriferous principle of the tonquin bean and the sweet scented woodruff, and of its homologues.

The artificial production of glycocol and of tartaric acid by Mr. Perkin conjointly with Mr. Duppa, afford other admirable examples of synthetical research, which excited very great interest among chemists at the time of their publication.

It is seldom that an investigator of organic chemistry has extended his researches over so wide a range as is the case with Mr. Perkin, and his work has always commanded the admiration of chemists for its accuracy and completeness, and for the originality of its conception.

A Royal Medal has been awarded to A. C. Ramsay, F.R.S. Prof. Ramsay has been for a period of nearly forty years connected with the Geological Survey of Great Britain, and during by far the greater part of that time either as Director or Director-General of the Survey. During this long period, in addition to his official labours in advancing our knowledge of the geology of this country, he has published works on the "Geology of Arran," "The Geology of North Wales," "The Old Glaciers of North Wales and Switzerland," and "The Physical Geology and Geography of Great Britain," now in its fifth edition. His papers in the *Quarterly Journal* of the Geological Society, and elsewhere, are numerous and important, especially those on theoretical questions in physical geology, such for instance, as "The Glacial Origin of Lake Basins," "The Freshwater Formation of the Older Red Rocks," and "The History of the Valley of the Rhine, and other Valleys of Erosion." There are, indeed, among living geologists few who can claim to have done more to extend our knowledge in the important fields of geology and physical geography.

The Davy Medal has been awarded to P. E. Lecoq de Boisbaudran. The discovery of the metal gallium is remarkable for having filled a gap which had been previously pointed out in the series of known elements. Mendelejeff had already shown that a metal might probably exist, intermediate in its properties between aluminium aud indium, before Boisbaudran's laborious spectroscopic and chemical investigation of numerous varieties of blende led him to the discovery and isolation of such a metal.

The separation of the minute traces of gallium compounds from blende is an operation presenting unusual difficulty, owing to the circumstance that compounds of gallium are carried down by various precipitates from solutions which are incapable by themselves of depositing those compounds.

EXPERIMENTAL DETERMINATION OF THE VELOCITY OF LIGHT[1]

II.

FIG. 7 represents a plan of the lower floor of the building. E is a three horse power Lovegrove engine and boiler, resting on a stone foundation; B, a small Roots' blower; G, an automatic regulator. From this the air goes to a delivery pipe up through the floor to the turbine. The engine made about four turns per second, and the blower about fifteen. At this speed the pressure of the air was about half a pound per square inch.

The regulator, Fig. 8, consists of a strong bellows, supporting a weight of 370 pounds, partly counterpoised by 80 pounds, in order to keep the bellows from sagging. When the pressure of the air from the blower exceeds the weight, the bellows commences to rise, and in so doing closes the valve, V.

This arrangement was found in practice to be insufficient, and the following addition was made: a valve was placed at P, and the pipe was tapped a little farther on, and a rubber tube led to a water gauge, Fig. 9. The column of water in the smaller tube is depressed, and when it reaches the horizontal part of the tube, the slightest variation of pressure sends the column from one end to the other. This is checked by an assistant at the valve, so that the column of water is kept at nearly the same point, and the pressure thus rendered very nearly constant. The result was satisfactory, though not in the degree anticipated. It was possible to keep the mirror at a constant speed for three or four seconds at a time, and this was sufficient for an observation. Still it would have been more convenient to have kept it so for a longer time. The test of uniformity was, however, very sensitive, as a change of speed of 0·02 of a revolution per second could be detected.

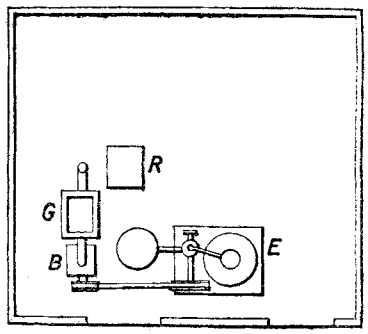

FIG. 7.

It was found that the only time during the day when the atmosphere was sufficiently quiet to get a distinct image was during the hour after sunrise or during the hour before sunset. At other times the image was "boiling," so as not to be recognisable. In one experiment the electric light was used at night, but the image was no more distinct than at sunset, and the light was unsteady.

The method followed in experiment was as follows:—The fire was started half an hour before, and by the time everything was ready the gauge would show 40 or 50 lbs. of steam. The mirror was adjusted by signals as before described. The heliostat was placed and adjusted. The revolving mirror was adjusted by being moved about till the light returned to it from the distant mirror. The axis of the revolving mirror was also inclined to

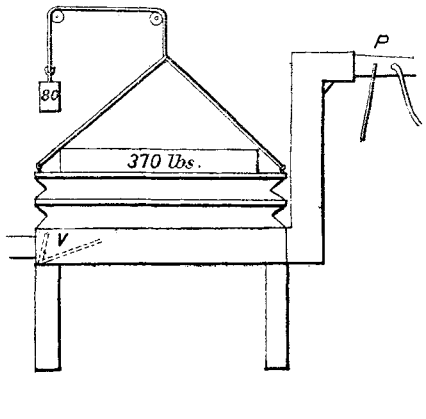

FIG. 8.

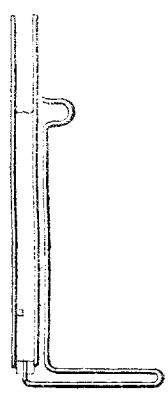

FIG. 9.

the right or the left, so that the direct reflection of light from the slit fell above or below the eyepiece, as otherwise this light would overpower that from the reflection from the distant mirror, &c., which forms the image to be observed. This inclination of the axis of rotation introduces a small error, which is duly allowed for in the calculations.

The distance between the front face of the mirror and the cross hair of the eyepiece was then measured, by stretching from one to the other a steel tape, making the drop of the catenary about an inch—when the error on account of the curve, and that due to the stretching of the tape, just counterbalanced each other.

The position of the slit, if not determined before, was then

[1] By Albert A. Michelson, Master, U.S. Navy. Read before the American Association. Continued from p. 96.